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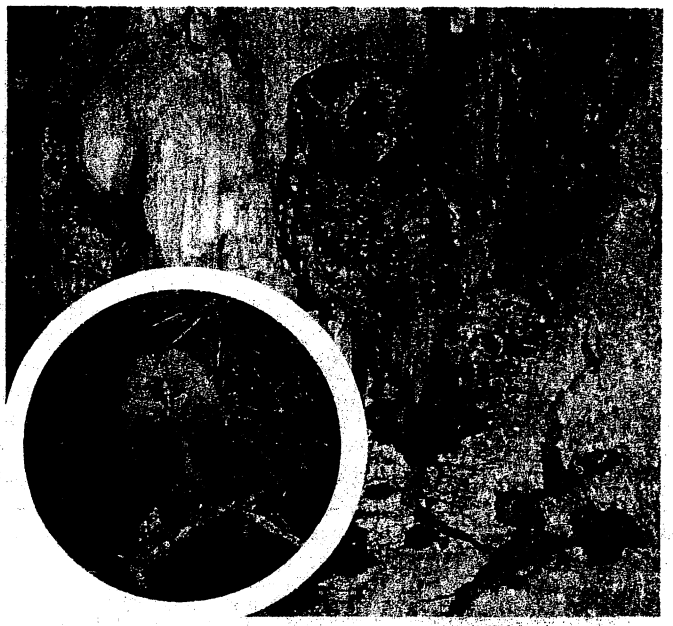
Flammulated, Boreal, and Great Gray Owls in the United States:

A Technical Conservation Assessment



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Abstract

Flammulated (*Otus flammeolus*), boreal (*Aegolius funereus*), and great gray (*Strix nebulosa*) owls occur over a broad portion of North America and each is designated as a "sensitive species" in four or more USDA Forest Service regions. The insectivorous **flammulated owl** is a neotropical migrant requiring suitable wintering habitat in the extreme southwestern United States, Mexico, and Central America as well as breeding habitat in the mountains of the western United States. Flammulated owls breed predominantly in yellow-pine (*Pinus ponderosa* and *Pinus jeffreyi*) forests and are cavity nesters. The mature and older ponderosa pine forests used as breeding habitat by flammulated owls have changed during the past century due to fire management and timber harvest. In contrast, the **boreal owl** is a nomadic, small mammal specialist that occurs as an "island" species occupying subalpine and boreal forests. Movements among populations are probably important to boreal owl persistence, and coordinated management of disjunct populations in different Forest Service regions may be important. While the boreal owl's high altitude spruce-fir forests have remained relatively undisturbed in the past, they are coming under increasing harvest pressure as the stock of lower elevation older stands are depleted or reserved. **Great gray owls** in the western United States occur in mid to high elevation conifer forests. These owls usually nest in mature and older forest stands using existing raptor nests or tops of broken trees and snags for a nest platform. The species' requirement of a secure nesting platform leads to one potential ecological limitation on population size. Prey availability is the other factor thought to limit populations. Flammulated and boreal owls may face significant conservation problems in the absence of conservation planning. Both owls are associated with older forest habitats. Limited research on these species indicates that their demography and life history coupled with their fairly narrow habitat associations make them vulnerable to habitat change. Current forest management practices in many areas (i.e., stand replacement systems) remove quality habitat for these species. Therefore, on at least a local basis, persistence of these species could be in jeopardy, even in the short term. Long-term concerns are greater because the habitats that seem most important to these species require one to two centuries to regenerate. Furthermore, the population biology of both species necessitates across-region planning to facilitate effective conservation planning. Based on limited information, the persistence of great gray owl populations in the United States over both the short and long-term is more certain. Great gray owl foraging habitat use is more compatible with current forest management practices. Our understanding of the ecology and biology of these three species is not sufficient to produce a conclusive assessment of their conservation status. The enclosed assessments, however, give a sufficiently clear picture of each owl's status and the dynamics of important forest habitats to influence management and research decisions. It is clear that development of conservation strategies would aid management but current knowledge of these species is insufficient to produce such a specific document.

Keywords: flammulated owl, boreal owl, great gray owl, *Otus flammeolus*, *Aegolius funereus*, *Strix nebulosa*, habitat relationships, old growth, forest dynamics, ponderosa pine forest, spruce-fir forest, conservation.

Cover photos, clockwise starting in the upper left corner:

**Adult great gray owl by Michael S. Quinton. Insert—juvenile great gray owl by James Duncan.
Adult flammulated owl by Richard T. Reynolds. Insert—juvenile flammulated owl by Richard T. Reynolds.
Adult boreal owl by Pat and Greg Hayward. Insert—juvenile boreal owl by Pat and Greg Hayward.**

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FLAMMULATED, BOREAL, AND GREAT GRAY OWLS IN THE UNITED STATES: A TECHNICAL CONSERVATION ASSESSMENT

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Chapter 17

Information Needs: Great Gray Owls

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INTRODUCTION

Current understanding of great gray owl biology and ecology is based on studies of less than five populations. In an ideal world, a strong conservation strategy would require significant new information. However, current knowledge suggests that conservation of this forest owl should involve fewer conflicts than either the boreal or flammulated owl. The mix of forest habitats used by great gray owls fit patterns that occur in managed forest landscapes when the maintenance of mature and older forest is an integral part of management planning. Therefore, immediate threats to the persistence of this owl on a local and regional basis are not great. Long-term threats may be significant if loss of open-structured, mature and older forest continues as in the last century. Addressing the long-term threat to persistence should be the target of management and research planning.

The absence of a current conservation crisis affords the opportunity to examine great gray owl response to forest management over a relatively long time frame and the luxury of building information on the species gradually and inexpensively. A research program could be built around testing potential management guidelines rather than simply gathering the basic information necessary to build the strategy. In this chapter I will assess the strength of existing knowledge in forming a conservation strategy. Then I will discuss efficient strategies for obtaining needed information. This chapter will include few citations because it relies on Chapters 14 and 15 which review literature on this species and some of the forests it inhabits.

STRENGTH OF EXISTING KNOWLEDGE TO FORMULATE A CONSERVATION STRATEGY

Throughout this section I approached each topic as a question. Is our understanding of this topic sufficient to support the development of a sound, national-scale conservation strategy for the great gray owl? For example, "is the response of great gray owls to stand level habitat change understood in sufficient detail to formulate a conservation strategy?"

Distribution

Systematic surveys for great gray owls have not been conducted in many areas. The owl's large size and its crepuscular activity, however, contribute to detection of individuals. Therefore, the range of great gray owls on a broad scale has been established with reasonable confidence. Delineating local distributions, especially in areas with little human activity, will require specific survey efforts. However, the owl's distribution is understood in sufficient detail to formulate regional conservation strategies.

The nature of links among populations (metapopulation structure) of the species is unknown. This information would aid in defining management units and in identifying habitats that may be critical in joining portions of metapopulations. Molecular studies examining small samples of individuals from populations throughout the species' range could begin to provide this information.

Response of Great Gray Owls to Stand-Level Habitat Changes

Habitat use by great gray owls has not been studied experimentally. Therefore the direct response of great gray owls (e.g., changes in habitat use) to stand-level changes have not been observed. However, observational studies of radio-marked individuals provide sufficient evidence to define broad habitat associations that can be used to develop initial management guidelines.

Knowledge of habitat use should be expanded through short-term, relatively small observational studies in several (four-five) new geographic settings representing forest types not covered in past studies. Understanding of factors influencing habitat use

ould be examined through two, more intensive, perimental studies conducted in association with ational Forest System commercial forest management. The goal of these studies should be a system rank habitat quality within a management area different functional uses (nesting, roosting, foraging).

The relationship between primary prey species and icrohabitat should be further examined with the al of producing predictive models describing the sponse of prey populations to alternative forest anagement actions. These studies should not be proached as isolated parts of a great gray owl research program but coordinated with efforts designed to understand the role of small mammals in rest systems and as prey for other forest predators.

Effects of Landscape-Scale Changes on Home Range Use

Studies of great gray owls have not examined the fluence of habitat characteristics at the landscape ale on home range characteristics or the reproductive success and survival of individuals and populations. Issues involving habitat use at the landscape ale have not been addressed in any research effort. Existing data show that great gray owls use rge home ranges and therefore demonstrate the ale that must be addressed when examining habitat use above the scale of stands.

Effects of Regional-Scale Habitat Changes on Movement Patterns

Studies in Oregon and Canada have shown that reat gray owls exhibit a mixed pattern of seasonal nd annual movements. In general, adults are sedntary; however, seasonal elevation movements ave been documented as well as long distance disersal of adults and juveniles. Environmental features which influence the survival of dispersing individuals and the paths used during dispersal have ot been addressed. Furthermore, how local habitat eatures influence the probability of individuals disersing from an established home range is unknown.

Effects of Stand-Level Habitat Changes on Foraging Behavior

Scientific literature on great gray owls includes nly general descriptions of foraging behavior. This nowledge is insufficient to begin forming a predictive model of the response of great gray owl foraging success to habitat change. Even the first step of developing a ranking of foraging habitat quality based on habitat structure would be tentative given our understanding of how foraging success changes among habitats. Knowledge of the effects of stand level habitat change on prey populations, prey biomass, and prey availability is crucial to predicting the consequences of forest management. This knowledge is not currently available.

Demography

Although reproduction of great gray owls has been documented in several geographic settings, survival and dispersal are much more poorly understood. In particular, how vital rates vary with habitat conditions is not understood. The interaction between environmental conditions (forest structure, prey populations, predators, competitors, landscape patterns) and demographic parameters must be understood prior to developing comprehensive management plans for great gray owls. This does not mean that management is not possible without data on the demography of every target population. Rather, patterns of change in demography across the species' range should be understood so that a reductionist approach to management is unnecessary.

Dynamics of Primary Plant Communities

Great gray owls inhabit a wide range of forest types. Forests used by this owl coincide with commercially valuable forest throughout much of the species' range. As a consequence, a relatively rich body of scientific literature exists on the dynamics of these forests. Forest ecologists understand the successional dynamics of these forests and the interaction of many of the disturbance agents. Understanding of the dynamics of forest species other than the dominant tree species is less complete. The role of small mammals (major prey of the great gray owl) in these forests is also poorly understood. Ecological processes important in edge habitats such as meadow-forest edges have been studied to some extent but are extremely important to this species and require further study. For example, the ecological interaction between small mammals occurring in meadows (and other forest openings) and forest stands are not well studied.

Broken-topped snags and broken-topped trees are important to great gray owls for nesting. The population dynamic of these structures are not understood and there is no basis from which to predict the stands most likely to produce potential nest structures. Understanding the role of fungi infections

and other pathogens in creation of nest trees will be important in forming the necessary predictive models. A system of ranking various mature and older stands in terms of the probability of providing nesting structures would be useful for management.

History of Distribution and Composition of Forest Communities

Scientists and managers are beginning to focus more attention on landscape history. Managers realize that descriptions of historic environments provide a window, although an opaque view, into the range of variation experienced by organisms in the past. Scientists understand that historical ecology can aid in understanding important ecological concepts such as successional patterns, community theory, and biogeography. Despite increased interest in historical ecology, scientific understanding of the historic abundance and distribution of montane conifer forests in the western United States is not sufficient to indicate how current patterns compare to the past. In particular, knowledge of patterns in distribution and abundance of older age classes of these forests is not available. Describing these patterns is extremely difficult.

Current efforts to put management impacts into a historic context seem to focus almost exclusively on what amounts to a snapshot of vegetation history —a documentation of forest conditions near the time when European settlers first began to impact forest structure. Conservation planning for great gray owls must also consider patterns in these forests thousands of years ago. The value of the historic information lies in the perspective it can provide on the potential variation in great gray owl distribution in the past and the forest conditions the species was exposed to. I do not believe that historical ecology, emphasizing static conditions in recent times, say 100 years ago, will provide the complete picture needed to place present conditions in a proper historic context. Conditions immediately prior to industrial development may have been extraordinary compared to the past 1,000 years or more. Using forest conditions in the 1800's as a baseline, then, could provide a false impression if the baseline is considered a goal to strive toward.

A RESEARCH PLAN

Given the limitations in funds available for ecological research, an applied research plan must consider the urgency of new knowledge and prioritize knowledge to be acquired. A research plan for a species in immediate peril will differ fundamentally from one targeting a common species. Therefore, a research plan for the great gray owl must be written in light of its conservation status.

Research on the great gray owl is predicated upon several conclusions based on the previous chapters. Scientific understanding of the ecology of great gray owls relevant to conservation is extremely limited. As described above, many important topics have received no attention and existing research is limited to 2-3 geographic locales. Many aspects of great gray owl ecology and biology (trophic position, aerial requirements, etc.) suggest some concern for persistence in the long term. However, habitat use patterns suggest that conservation of this owl is not necessarily at odds with forest land management in which conservation of biological diversity is a priority equal to commodity development.

Based on these factors, research on great gray owls should be approached as a long-term proposition without the extreme sense of urgency afforded species in peril. Broad-scale and long-term questions may be given a priority equal to that of short-term management needs. Furthermore, experimental studies designed in conjunction with National Forest System management activities should be a strong component of any research program.

Establish Research Goals

Research funded to support development of a conservation strategy for great gray owls should meet one of several broad goals: 1) Research should develop predictive models (qualitative or quantitative) to assist in evaluating management alternatives; 2) research should strive to understand the mechanisms responsible for differential breeding success and survival among habitats, differential dispersal of owls among habitats, and differences in home range characteristics; and 3) research should examine ways to place conservation of great gray owls in an ecosystem management context.

Develop Predictive Models

Conservation planning requires methods to predict the outcome of alternative management scenarios. These methods must consider complex ecological interactions and feedback loops among various components of forest ecosystems and must deal with processes at a variety of scales. Qualitative word models supported by quantitative submodels, where appropriate, would be most efficient to implement in management. These models should address stand, landscape, and watershed scale evaluations of the

pact of habitat change on either individual owl roduction and survival, or population persis-ıce. Because of the expense of developing com-ehensive quantitative models and because man-ment decisions require proper ranking of alter-ves rather than precise enumeration of outcomes, odels should be designed to rank habitat quality. The data needed to support development of pre-ctive models will come from a diversity of indi-lual research projects and further reviews of ex-ing literature. Some priorities for specific research outlined below under Specific Research Topics. is research should be coordinated by the scientist scientists responsible for building management-ented models to assure that the research products pport model development. Furthermore, research ould be coordinated with research units involved th other forest predators, small mammals, and est dynamics to avoid redundant efforts.

Examine Mechanisms

Resources to fund research are limited. Therefore, eat gray owls, or any other species, cannot be stud-l in all geographic and environmental settings. anagement, therefore, cannot take a reductionist proach and expect to base decisions on local owledge. Instead, research must provide the ba-for managers to use an inferential approach. Re-arch that asks "why" can aid in extrapolating re-lts from one setting to another. Inferences concern-g owl habitat associations, small mammal abun-ance, etc., should be based on an understanding of tterns in certain locales and understanding the echanisms responsible for those patterns. For in-ance, if great gray owls are observed to nest pri-arily in mature and older Douglas-fir stands in an ea, the reason for that pattern should be examined. nowledge of the mechanism will facilitate extrapo-tion of results to new areas. Studies directed to-ard understanding "why" will not yield unequivo-l answers but the range of potential reasons can reduced and aid in understanding the ecology of e species.

Use Ecosystem Management

The broad-scale persistence of great gray owls in e United States is not a short-term concern. Be-use of the mix of habitats used by great gray owls, nagement for this species should not place severe nstraints on other management goals as long as esting habitat is maintained to be well dispersed roughout the owl's range. Therefore, research should focus on placing great gray owl management in an ecosystem context. As with boreal and flammulated owls, the ecology of great gray owls integrates many aspects of the forest system in which they occur. Therefore research that examines the dynamics of those links will provide knowledge useful in managing the system under a holistic philosophy. This research should dovetail with work on other forest owls as well as forest carnivores that are sensitive species throughout the western United States.

Specific Research Topics

Although the above discussion emphasizes a general direction for research, certain topics should receive priority in the early stages of a research program. These are topics that have received little attention in the past and would provide immediate input into management.

How do different habitat configurations at the landscape and broader scales influence the reproductive success of owl pairs and the probability of persistence for owl populations? Habitat quality at the landscape and regional scales has not been examined. Because many forest management activities influence the mosaic of habitats within watersheds, understanding the response of great gray owl populations to these activities are fundamental to conserving the species. Unfortunately, experiments at this scale are difficult because of the problems of studying multiple landscapes.

How is the survival of adult great gray owls influenced by habitat change? Great gray owls are long-lived and have relatively low effective reproduction. These characteristics fit the pattern of other species whose life history has been analyzed through demographic sensitivity analysis (Lande 1988, Caswell 1989). Analyses demonstrate that the persistence of populations like these are most sensitive to survival of adults. An understanding of changes in habitat that increase predation upon adults, reduce foraging success, or increase rates of adult dispersal will aid in evaluating population persistence under alternative management.

How can the response of great gray owl populations to habitat change be monitored efficiently? In certain circumstances managers will need to monitor the response of great gray owls to habitat change. Research must devise efficient monitoring methods. Rather than relying on broad-scale monitoring of territories as is done for some raptor species, I suggest testing methods to examine reproductive parameters and presence/absence as outlined in Hay-

ward *et al.* (1992). Methods to monitor adult survival would be especially useful.

How do the population dynamics of potential nest platforms vary with habitat structure? A nest platform is one of the few absolute requirements of great gray owls and a potential limiting factor under forest management that limits the extent of mature and older forest habitats. The availability of nest platforms likely differs among forest types (species composition) and forest ages within a forest type. Therefore forest management could be improved with knowledge of which forest stands are most likely to have nesting platforms now and in the future.

During both winter and summer, how is great gray owl foraging efficiency influenced by vegetation structure? As a species whose populations are frequently food limited, great gray owl persistence will depend in large part on whether or not the habitats in an area facilitate foraging. Knowledge of great gray owls and their prey that permits a ranking of habitats in terms of predicted foraging efficiency (dependent upon the effect of forest structure on both owl mobility and perception, and upon prey availability) would aid managers in choosing among stand management prescriptions.

This list of information needs is not complete. It is not intended as a template but as a set of ideas to stimulate discussion. A real research plan for the great gray owl, or other sensitive species, will depend upon a broader agreement of the urgency of the conservation problem, available funding, and opportunities to corroborate with scientists working on related problems.

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